इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”
Mazdoor Kisan Shakti Sangathan
“The Right to Information, The Right to Live”

“पुराने को छोड नये के तरफ”
Jawaharlal Nehru
“Step Out From the Old to the New”

IS 2772 (1982): Non-flameproof mining transformers for use below ground [ETD 16: Transformers]

“ज्ञान से एक नये भारत का निर्माण”
Satyanarayan Gangaram Pitroda
“Invent a New India Using Knowledge”

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

Made Available By
Public.Resource.Org

“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”
Bhartṛhari—Nītiśatakam
“Knowledge is such a treasure which cannot be stolen”

BLANK PAGE

BRUTUM FULMEN

IGNORANTIA JURIS NON EXCUSAT

PROTECTED BY COPYRIGHT

IS : 2772 - 1982

(Reaffirmed 2001)

Indian Standard

SPECIFICATION FOR NON-FLAMEPROOF MINING TRANSFORMERS FOR USE BELOW GROUND

(*First Revision*)

UDC 621·314·212 : 622

© *Copyright* 1982

INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 4

September 1982

Indian Standard
SPECIFICATION FOR NON-FLAMEPROOF MINING TRANSFORMERS FOR USE BELOW GROUND
(First Revision)

Transformers Sectional, Committee, ETDC 16

Chairman	*Representing*
Shri C. R. Varier	Crompton Greaves Ltd, Bombay
Members	
Shri S. V. Manerikar (*Alternate* to Shri C. R. Varier)	
Shri R. S. Arora	Directorate General of Supplies and Disposals (Inspection Wing), New Delhi
Shri D. R. Chandran (*Alternate*)	
Shri A. V. Bheemarao	Gujarat Electricity Board, Vadodara
Shri S. H. Makhijani (*Alternate*)	
Shri A. Chatterjee	Calcutta Electric Supply Corporation Ltd, Calcutta
Shri T. K. Ghosh (*Alternate*)	
Shri S. D. Chotraney	Bombay Electric Supply and Transport Undertaking, Bombay
Shri Y. K. Palvankar (*Alternate*)	
Shri D. Dhar	The General Electric Co of India Ltd, Allahabad
Shri B. A. Subramanyam (*Alternate*)	
Director	Central Power Research Institute, Bangalore
Shri C. S. Sarma (*Alternate*)	
Director (Substation)	Central Electricity Authority, New Delhi
Deputy Director (Substation) (*Alternate*)	
Shri G. L. Dua	Rural Electrification Corporation Ltd, New Delhi
Shri S. C. Khurana (*Alternate*)	
Joint Director TI (Substation)	Research, Designs and Standards Organization, Lucknow
Deputy Director Standards [(Elec)-C2] (*Alternate*)	
Dr M. V. Joshi	Electrical Research and Development Association, Bombay
Shri P. K. Joshi (*Alternate*)	
Shri D. B. Mehta	Tata Hydro-Electric Power Supply Co Ltd, Bombay
Shri R. Chandramouli (*Alternate*)	

(*Continued on page* 2)

© *Copyright* 1982

INDIAN STANDARDS INSTITUTION

This publication is protected under the *Indian Copyright Act* (XIV of 1957) and reproduction in whole or in part by any means except with written permission of the publisher shall be deemed to be an infringement of copyright under the said Act.

(*Continued from page* 1)

Members	*Representing*
SHRI M. L. MITTAL	Bharat Heavy Electricals Ltd, Bhopal
SHRI PREM CHAND (*Alternate* I)	
SHRI D. P. GUPTA (*Alternate* II)	
SHRI T. OM KUMAR	NGEF Ltd, Bangalore
SHRI P. S. RAMAN (*Alternate*)	
SHRI R. G. PARDHANANI	Bharat Bijlee Ltd, Bombay
SHRI V. S. PATIL (*Alternate*)	
DR G. M. PHADKE	Indian Electrical Manufacturer's Association, Bombay
SHRI P. K. PHILIP (*Alternate*)	
SHRI V. N. PRAHLAD	Voltas Ltd, Pune
SHRI T. B. SEN (*Alternate*)	
SHRI CHANDRA K. ROHATGI	Pradip Lamp Works, Patna
SHRI P. S. SAWHNEY	Delhi Electricity Supply Undertaking, New Delhi
SHRI B. B. DASS (*Alternate*)	
SHRI R. K. SEHGAL	Bombay Suburban Electric Supply Ltd, Bombay
SHRI H. S. NATARAJAN (*Alternate*)	
SUPERINTENDING ENGINEER (TECHNICAL PROJECTS)	Andhra Pradesh State Electricity Department (Electricity Projects and Board), Hyderabad
SUPERINTENDING ENGINEER (GRID OPERATION) (*Alternate*)	
DR VAKIL AHMED	Directorate General of Technical Development, New Delhi
SHRI S. K. PALHAN (*Alternate*)	
SHRI T. V. VIDYARATNA RAJ	Kirloskar Electric Co Ltd, Bangalore
SHRI M. D. KALLIANPUR (*Alternate*)	
SHRI S. P. SACHDEV, Director (Elec tech)	Director General, ISI (*Ex-Officio Member*)

Secretary

SHRI K. M. BHATIA

Deputy Director (Elec Tech), ISI

Indian Standard
SPECIFICATION FOR NON-FLAMEPROOF MINING TRANSFORMERS FOR USE BELOW GROUND
(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 11 June 1982, after the draft finalized by the Transformers Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard covers the non-flameproof type mining transformers and forms part of a series of Indian Standards relating to several items of electrical equipment used in mines and other hazardous locations, that have been drawn up.

0.3 This standard was first published in 1964 which covered non-flameproof mining transformers up to 315 kVA rating. Present revision has been undertaken to extend the rating up to 500 kVA and to align the requirements with IS : 2026 (Part I)-1977*, IS : 2026 (Part II)-1977†, IS : 2026 (Part III)-1981‡, and IS : 2026 (Part IV)-1977§ which are necessary adjunct to this standard. Should, however, any deviation exist between the requirements of IS : 2026 (Part I)-1977*, IS : 2026 (Part II)-1977†, IS : 2026 (Part III)-1981‡, or IS : 2026 (Part IV)-1977§ and those of this standard, the provisions of the latter shall apply.

0.4 For the purpose of deciding whether a particular requirements of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960||. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

---

*Specification for power transformers : Part I General (*first revision*).

†Specification for power transformers : Part II Temperature-rise (*first revision*).

‡Specification for power transformers : Part III Insulation level and dielectric tests (*second revision*).

§Specification for power transformers : Part IV Terminal marking, tappings and connections (*first revision*).

||Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard covers requirements for single and three-phase non-flameproof, mining type, oil-immersed transformers for use below ground.

NOTE — Single-phase transformers are normally used for lighting purposes.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 1885 (Part XXXVIII)-1977* shall apply.

3. RATING

3.1 Rated kVA — The rated kVA shall be:

a) 5 and 10 kVA for single-phase transformers; and

b) 160, 200, 250, 315 and 500 kVA for three-phase transformers.

3.2 Rated Voltage

3.2.1 The rated primary voltage for both single-phase and three-phase transformers shall be 433 V, 3 300 V, 6 600 V, and 11 000 V.

NOTE — 433 V supply is required for single and three-phase tranrformers used for underground lighting.

3.2.2 The rated secondary voltage shall be 115 V, 433 V, 565 V, 1 130 V and 3 300 V. For single-phase lighting transformers, the secondary voltage shall be 115 V with the mid-point earthed.

3.3 Rated Frequency — The rated frequency for the purpose of this standard shall be 50 Hz.

4. PERFORMANCE

4.1 Transformers shall comply with the requirements of IS : 2026 (Part I)-1977†, IS : 2026 (Part II)-1977‡, IS : 2026 (Part III)-1981§ and IS : 2026 (Part IV)-1977|| as applicable.

4.2 Tolerances — The tolerances as given in Table 7 of IS : 2026 (Part I)-1977† shall be permissible on the values to be declared by the manufacturer.

---

*Electrotechnical vocabulary : Part XXXVIII Transformers (*first revision*).

†Specification for power transformers : Part I General (*first revision*).

‡Specification for power transformers : Part II Temperature-rise (*first revision*).

§Specification for power transformers : Part III Insulation level and dielectric tests (*second revision*).

||Specification for power transformers : Part IV Terminal marking, tappings and connections (*first revision*).

5. WINDING CONNECTIONS AND TAPPINGS

5.1 The winding connections for three-phase transformers shall be delta on the primary side and star on the secondary side. The vector group shall be Dyn 11 [*See* IS : 2026 (Part IV)-1977*].

5.2 Adjusting tappings shall be provided on the primary voltage winding for a primary voltage adjustment of +2·5, −2·5, −5 and −7·5 percent of the rated voltage.

5.2.1 A readily accessible off-circuit tap selecting device shall be provided for tap changing.

6. TERMINALS AND CONNECTIONS

6.1 All bushings and live parts inside the transformer tank shall be below the cold oil level.

6.2 Detachable cable sealing boxes shall be provided for the reception of multi-core metal-sheathed or armoured cables for connections to the high-voltage and low-voltage terminals.

6.3 The cable sealing box shall be fitted to or incorporated in an air-filled chamber which shall be provided on the transformer tank to cover the terminals.

6.4 The arrangement for cable termination shall be such that cables with the cable boxes attached can be disconnected and detached from the transformer without the sealing compound, where provided, having to be disturbed.

6.5 Cable sealing boxes shall have standard flanges and be attached to standard facings. The facings and fixing dimensions shall be in accordance with Fig. 1.

6.5.1 Cable couplers may be used, provided provision is made for the fitting of cable sealing chamber.

6.6 It shall be possible to fit and remove the cable sealing boxes without either exposing the interior of the transformer tank or moving the bushing.

6.7 Cable Glands

6.7.1 A cable gland for lead-sheathed cable shall include means for receiving and securely attaching the lead sheath of the cable to the gland so as to ensure good contact between them, without damaging the lead sheath or the insulating material of the cable. The cable gland shall be so designed as to minimize the damage or dislocation of the wire armouring.

---

*Specification for power transformers : Part IV Technical marking, tappings and connections (*first revision*).

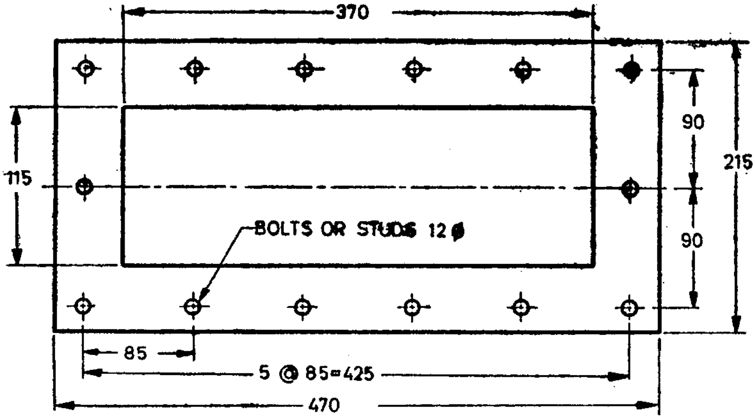

FIG. 1 FLANGE FACING FOR CABLE SEALING BOX UP TO AND INCLUDING 3 300 VOLTS

6.7.2 A cable gland shall have provision for securely attaching the wire armouring of the cable to the gland. A coned draw-gland may be used for attaching the wire armouring of the cable in which case the included angle of the cone shall be as small as practicable but shall in no case exceed 60°. A typical gland suitable for lead-sheathed wire armoured cable is shown in Fig. 2.

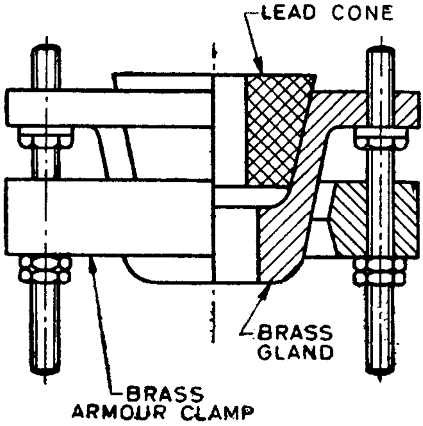

FIG. 2 TYPICAL ARRANGEMENT OF GRIP GLAND

6.8 A mechanical clamp for the cable connection shall be provided at each bushing terminal. Soldered joints shall not be used.

> NOTE — Typical methods of complying with the above requirements are shown in Fig. 3 and 4.

7. OVER-VOLTAGE PROTECTION AND EARTHING

7.1 General — Provision shall be made to enable the low-voltage windings and leads to be protected against the consequences of leakage from, or contact with, the high-voltage winding. Unless a special earthing device is used, this provision shall be in the form of a connection to earth of a permissible point of the low-voltage winding.

7.2 Unless otherwise specified, the neutral point of the low-voltage winding of a three-phase transformer and the mid-point of the low-voltage winding of a single-phase transformer shall be brought out through a separate bushing for the purpose of earthing.

7.2.1 The bushing and the earthing link shall be enclosed in a housing attached to the transformer tank so as to facilitate removal of the link for the purpose of testing (*see* Fig. 3).

7.3 Two external earthing terminals shall be provided to enable the tank to be securely and efficiently earthed irrespective of any means provided for attaching to the cable gland the metallic covering of the cables connected to the transformer.

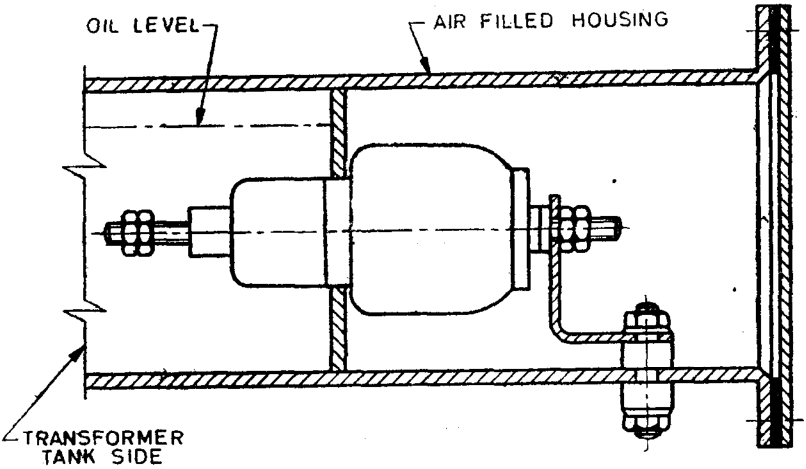

FIG. 3 NEUTRAL POINT TERMINAL AND HOUSING

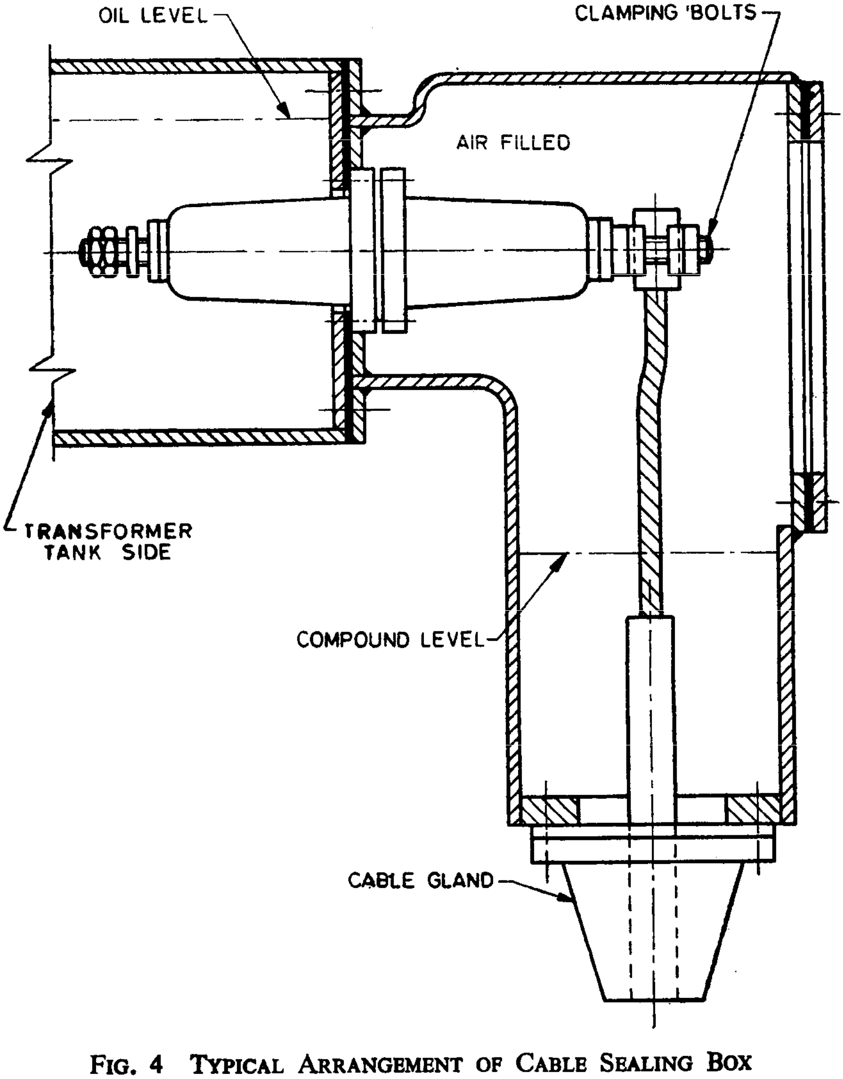

FIG. 4 TYPICAL ARRANGEMENT OF CABLE SEALING BOX

7.4 A mechanical clamp type of connection shall be provided for the earthing connections. Soldered joints shall not be used.

8. TANKS

8.1 The tank shall be made of mild steel plate and shall be of substantial construction in order to withstand the rough conditions of handling to which the transformer may be subjected, particularly when being pushed into and out of cages and when being transported below ground in any position except upside down.

NOTE — It is not intended that the cooling tubes or fins, if any, should be capable of sustaining the weight of the transformer and steps should be taken by the user to avoid these parts being strained during handling and transport.

8.1.1 No aluminium, or alloys of aluminium, or magnesium, or paint containing aluminium shall be employed on exterior part of the transformer tank or fittings.

8.2 The tank shall be of oil-tight construction and shall show no sign of leakage when tested with cold transformer oil for a period of six hours to a pressure of 35 kPa measured at the top of the tank. The tank construction shall be of a non-free-breathing type.

8.3 The tank lid, and inspection covers, if any, shall be so arranged that they can be removed and replaced without disturbing the cable connections.

9. LIFTING AND ANCHORING OF CORE

9.1 The core and winding assembly shall be provided with means for attaching lifting tackle.

9.2 Means shall also be provided to ensure correct registration of the core in the tank, and to prevent movement of the core and windings when the tank is on its side or end.

10 FITTING

10.1 Fittings as listed in Table 1 shall be provided.

11. OVERALL DIMENSIONS

11.1 For the transformers covered by this specification, the overall dimensions shall not exceed the following values :

Length	*Width*	*Height*
mm	mm	mm
2 500	1 200	1 400

NOTE 1 — The dimensions relate to the transformer and exclude wheels and axles, cable boxes and other attachments.

NOTE 2 — In case of low-head room, the figures are liable to adjustment.

TABLE 1 FITTINGS FOR MINING TYPE OIL-IMMERSED TRANSFORMERS

(*Clause* 10.1)

SL No.	ITEM	REMARKS
i)	Flush or protected type level indicator	For three-phase transformers only
ii)	Thermometer pocket	For three-phase transformers only
iii)	a)* Oil drain-cum-sampling valve with dummy plug or blanking plate fitted with a locking device to prevent unauthorized operation	For three-phase transformers only
	b) Oil-drain-plug, fitted with a locking device to prevent unauthorised operation	For single-phase transformers only
iv)	Venting device, provided with a suitable arrangement to prevent leakage of oil during transport	Provided to relieve pressure due to normal expansion of the oil-whilst preventing free breathing
v)	Lifting lugs, each fitted with a shackle	a) For three-phase transformers, four lugs shall be provided, two on each side b) For single-phase transformers, two lugs shall be permissible, one at each end Each lug and shackle shall be of sufficient strength to support the whole weight of the transformers when slung by any one lug
vi)	Means for attachment of haulage chains to the base or fender of the tank	For three-phase transformers only
vii)	Provision for the mounting of axles fitted with flanged rollers having a tread diameter of 305 mm and a bore of 40 mm diameter	The rollers and axles may be provided by the purchaser. Provision shall be made in the roller mounting for setting the clearance between rail level and the bottom of the transformer tank at either 25 mm or 125 mm Unless otherwise specified, the roller shall be arranged for a rail guage of 610 mm.

* A protective device shall be provided to prevent damage during handling.

12. INFORMATION TO BE GIVEN WITH ENQUIRY OR ORDER

12.1 To enable the supplier to offer, the purchaser shall furnish the following information:

- a) Rated kVA;
- b) Rated voltages: Primary and secondary;
- c) Number of phases;
- d) Details of rollers. These should include the rail gauge required;
- e) Full details of cables intended to be used; and
- f) Restriction on overall dimension, if any.

13. MARKING

13.1 The transformer shall be provided with a rating plate securely fitted to it in a visible position, containing the following information:

- a) Name of the equipment, namely, non-flameproof oil immersed mining transformer for use below ground;
- b) Number of this standard, Ref IS : 2772-1982.
- c) Manufacturer's name;
- d) Rated kVA;
- e) Rated voltage;
- f) Rated current;
- g) Rated frequency;
- h) Number of phases;
- j) Connection symbol;
- k) Percent impedance voltage at rated current (corrected to 75°C);
- m) Manufacturer's serial number;
- n) Year of manufacture;
- p) Total mass; and
- q) Mass and volume of insulating oil.

13.2 The transformer shall also be provided with a terminal marking plate giving the information in accordance with IS : 2026 (Part IV)-1977*.

13.3 The entries on the rating plate shall be indelibly marked (for example, by etching, engraving or stamping). The plates shall not be enamlled nor made of aluminium or aluminium alloy.

---

*Specification for power transformers: Part IV Terminal, marking, tappings and connections (*first revision*).

13.4 The transformer may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act, and Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard, under a well-defined system of inspection, testing and quality control which is deviced and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processorr, may be obtained from the Indian Standards Institution.

14. TESTS

14.0 The tests shall be carried out in accordance with IS : 2026 (Part I)-1977*, IS : 2026 (Part II)-1977†, IS : 2026 (Part III)-1981‡ and IS : 2026 (Part IV)-1977§, unless otherwise specified.

14.1 Type Tests — The following shall constitute type tests:

a) Measurement of insulation resistance;

b) Voltage ratio and voltage vector relationship;

c) No load loss and current;

d) Winding resistance, impedance voltage/short circuit impedance and load lose;

e) Separate source voltage withstand test;

f) Induced overvoltage withstand test;

g) Oil leakage test on tank (**8.2**); and

h) Temperature-rise.

14.2 Routine Tests — The following shall constitute routine tests:

a) Measurement of insulation resistance;

b) Voltage ratio and voltage-vector relationship;

c) No load loss current;

d) Winding resistance, impedance voltage/short circuit impedance and load loss;

---

*Specification for power transformers : Part I General (*first revision*).

†Specification for power transformers : Part II Temperature-rise (*first revision*).

‡Specification for power transformers: Part III Insulation level and dielectric tests (*second revision*).

§Specification for power transformers: Part IV Terminal marking, tappings and connections (*first revision*).

e) Separate source voltage withstand test;

f) Induced overvoltage withstand test; and

g) Oil leakage test on tank (**8.2**).

14.3 Special Tests — The following tests may be carried out by mutual agreement between the purchaser and the supplier:

a) Short-circuit test, and

b) Zero-sequence impedance of three-phase transformers.

INDIAN STANDARDS

ON

TRANSFORMERS

IS :

1180 (Part I)-1981 Outdoor type three-phase distribution transformers up to and including 100 kVA 11 kV : Part 1 Non sealed type (*second revision*)

1180 (Part II)-1979 Outdoor three-phase distribution transformers up to and including 100 kVA 11 kV : Part II sealed type

1885 (Part XXXVIII)-1977 Electrotechnical vocabulary : Part XXXVIII Transformers (*first revision*)

2026 (Part I)-1977 Power transformers : Part I General (*first revision*)

2026 (Part II)-1977 Power transformers : Part II Temperature-rise (*first revision*)

2026 (Part III)-1981 Power transformers : Part III Insulation level and dielectric tests (*second revision*)

2026 (Part IV)-1977 Power transformers : Part IV Terminal marking, tappings and connections (*first revision*)

2772-1982 Non-flameproof mining transformers for use below ground (*first revision*)

3151-1982 Earthing transformers (*first revision*)

3639-1966 Fitting and accessories for power transformers

5553 (Part I)-1970 Reactors : Part I Shunt reactors

5553 (Part II)-1970 Reactors : Part II Series reactors

5553 (Part III)-1970 Reactors : Part III Neutral earthing reactor and arc suppression coil

6600-1972 Guide for loading of oil immersed transformers

8447-1977 Manually operated voltage regulators for domestic use

8448-1977 Automatic line voltage correctors (step type for domestic use)

8468-1977 On-load tap changers

8478-1977 Application guide for on-load tap changers

9147-1979 Cable sealing boxes for oil immersed transformers suitable for paper insulated lead sheated cables for highest system voltages from 12 kV up to and including 36 kV

9815-1981 Servo-motor operated live voltage correctors

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	*Unit*	*Symbol*
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of subsrance	mole	mol

Supplementary Units

Quantity	*Unit*	*Symbol*
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	*Unit*	*Symbol*	*Definition*
Force	newton	N	1 N = 1 kg. m/s^{2}
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^{2}
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^{2}

INDIAN STANDARDS INSTITUTION

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002

Telephones : 27 01 31, 26 60 21 **Telegrams : Manaksanstha**

Regional Offices:

		Telephone
Western : Novelty Chambers, Grant Road	BOMBAY 400007	37 97 29
Eastern : 5 Chowringhee Approach	CALCUTTA 700072	27 50 90
Southern : C. I. T. Campus	MADRAS 600113	41 24 42
Northern : B69, Phase VII	S.A.S. NAGAR (MOHALI) 160051	–

Branch Offices:

'Pushpak', Nurmohamed Shaikh Marg, Khanpur	AHMADABAD 380001	2 03 91
'F' Block, Unity Bldg, Narasimharaja Square	BANGALORE 560002	22 48 05
Gangotri Complex, Bhadbhada Road, T. T. Nagar	BHOPAL 462003	6 27 16
22E Kalpana Area	BHUBANESHWAR 75101	5 36 27
5-8-56C L. N. Gupta Marg	HYDERABAD 500001	22 10 83
R 14 Yudhister Marg, C Scheme	JAIPUR 302005	6 98 32
117/418 B Sarvodaya Nagar	KANPUR 208005	4 72 92
Patliputra Industrial Estate	PATNA 800013	6 28 08
Hantex Bldg (2nd Floor), Rly Station Road	TRIVANDRUM 695001	32 27

Printed at Delhi Printers, Delhi, India